
Railroad Crossing Safety Technologies

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Part 3: Evaluation of LED Signal Systems
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EXECUTIVE SUMMARY

The use of light emitting diode (LED) warning signals in the railroad industry has increased due to recent technological improvements. LED signals have many potential benefits over traditional incandescent signals, including longer life, increased durability, and lower power consumption. Traditional incandescent signals consist of a single incandescent bulb, and therefore, experience total failure when the bulb is out. However, since an LED signal consists of an array of individual LEDs, partial failure may occur when only a portion of the LEDs fail. Partial failure may be caused by vandalism, defective LED elements, or individual LEDs burning out. Safety concerns arise if an LED signal is not visible to an approaching train crew or vehicle driver. Therefore, it is necessary to determine the effects of an LED signal partial failure on the ability of an approaching train crew or vehicle driver to accurately see the warning signal.

The 12 inch LED crossing signals tested in this project can be categorized as being with or without a power supply or regulator to control the voltage and current supplied to the LED circuit. In the lab tests, the two signals that do not use power supplies exhibited maximum light intensities (in candela) that were a strong function of both the supply voltage and the number of active LED elements. The four LED crossing signals and the three LED wayside signals exhibited maximum light intensities that were much less sensitive to either the supply voltage or the number of active LED elements. Consequently, there is no overall conclusion that can be drawn about the light intensity output of an LED signal without knowledge of the way the signal is constructed.

A field test procedure was developed to determine how an individual perceives the partial failure of an LED signal light. A manually operated switch system was designed and built to select different patterns of non-illuminated LEDs. In addition, signal housings and test stands were designed and built to display LED signals during field tests. Two field tests were conducted using volunteers, who evaluated four 12 inch, red, LED railroad crossing signals at distances between 100 and 1500 ft. The volunteers evaluated the lights in different combinations of partial failures during each test. The field test indicated that the on/off status of an LED signal was usually determined correctly if 50% or more of the LED elements were active.